WORK PRODUCT FRAMEWORK
of the
HYDROLOGY COMMITTEE

I. GAGE DESCRIPTIONS

Deliverable: Information will be provided in a concise and consistent format that includes a narrative and numerical description of the USGS gage.

Objective: The Gage Description template will be used by the BBEST members for an initial assessment of the qualitative features and quantitative hydrologic components which are represented in the stream flow time series at each gage and over a specified period of record or multiple periods of record.. These Gage Descriptions will be included in the BBEST's final report.

Narrative Component

The narrative for each gage will provide the reader with the following:

1. the geographic description of the gage including a small map, amount of upstream drainage area, geologic features and land use upstream,
2. TCEQ stream segment description,
3. identification of nearby riparian zone habitats,
4. the dates available for gaged flow, i.e., the period of record,
5. a description of any important upstream changes such as dates for reservoir construction or modifications to land use over time, and
6. the reason(s) for dissecting the gaged period of record into pre-impact versus post-impact sub periods.

Numerical Component

The numerical description for each gage will provide the reader with the following:

1. basic statistical information about the gaged flows, such as the median daily flow rates per month and the TCEQ published 7Q2
2. characterization of the hydrologic conditions (dry, avg, wet?) based on a relative comparison of the annual or seasonal flows in the gaged flow sub periods,
3. an IHA (or possibly MBFIT) generated statistical comparison of the pre-impact and post-impact sub periods and possibly comparisons against the full gaged period of record,
4. a summary of the TCEQ WAM naturalized monthly or annual flows at the location and comparisons against the gaged flow sub periods,
5. exploration of any unique hydrologic characteristics at a particular gage, including trend detection.

II. HEFR BASED FLOW REGIMES

Deliverable: Draft HEFR based attainment frequency based flow regimes will be provided to the biological and ecological committees of the BBEST for each of the sub periods deemed to be necessary. A final HEFR based attainment frequency based flow regime will be included in the BBEST's final report.

Objective: The flow regime, as produced by HEFR, will be refined by the hydrology committee through an iterative process of collaboration with the biological and ecological committees. The Gage Descriptions are a preamble to initiating this process. A final HEFR based flow regime will be achieved at each gaged location when no further changes to the HEFR input parameters are required by the biological and ecological committees.

HEFR Based Flow Regime vs. the Final Flow Regime

The hydrology committee's final HEFR based flow regime will be included as supporting material in the BBEST's final report. However, the Final Flow Regime of the BBEST may differ from the numerical output of HEFR based on overlays conducted by the biological and ecological committees.

Hydrology Framework Example

Colorado River at Columbus, TX

Sub-Basin Description The drainage area for this gage is 41,640 mi² of which 11,403 mi² probably is noncontributing. The gage is located about 160 miles downstream of Austin and the last of the Highland Lakes (Lady Bird Lake), which regulate flows from the upper and Middle parts of the Colorado basin (about 39,000 mi²). There are many other diversions above this station for irrigation (Lakeside, Garwood, Pierce Ranch, Gulf Coast and two diversions at Bay City) and municipal supply including diversions for the LCRA Fayette Power Plant Project (Mosier and Ray 1992 - need to check to see if info is current).

The gage is on TCEQ Segment 1402 which extends approximately 150 miles from downstream of La Grange to just below Bay City. It begins in the Texas Blackland Prairies, Crosses the East Central Texas Plans and terminates in the Western Gulf Plain. The channel is characterized by occasional sandstone and limestone outcrops which tend to occur in isolated bands separated by long reaches of typical gravel-bedded stream. The lower part of the segment includes extensive sand reaches with braided channel pattern typical of river with fine bed material. Presence of the state threatened Blue Sucker (*Cyceptus elongatus*) led the TPWD's recommendation that the segment be designated an ecologically significant stream segment. While the segment supports its designated uses, data indicate elevated nutrient levels and low DO levels. (CRP basin highlights report 2008[1]).

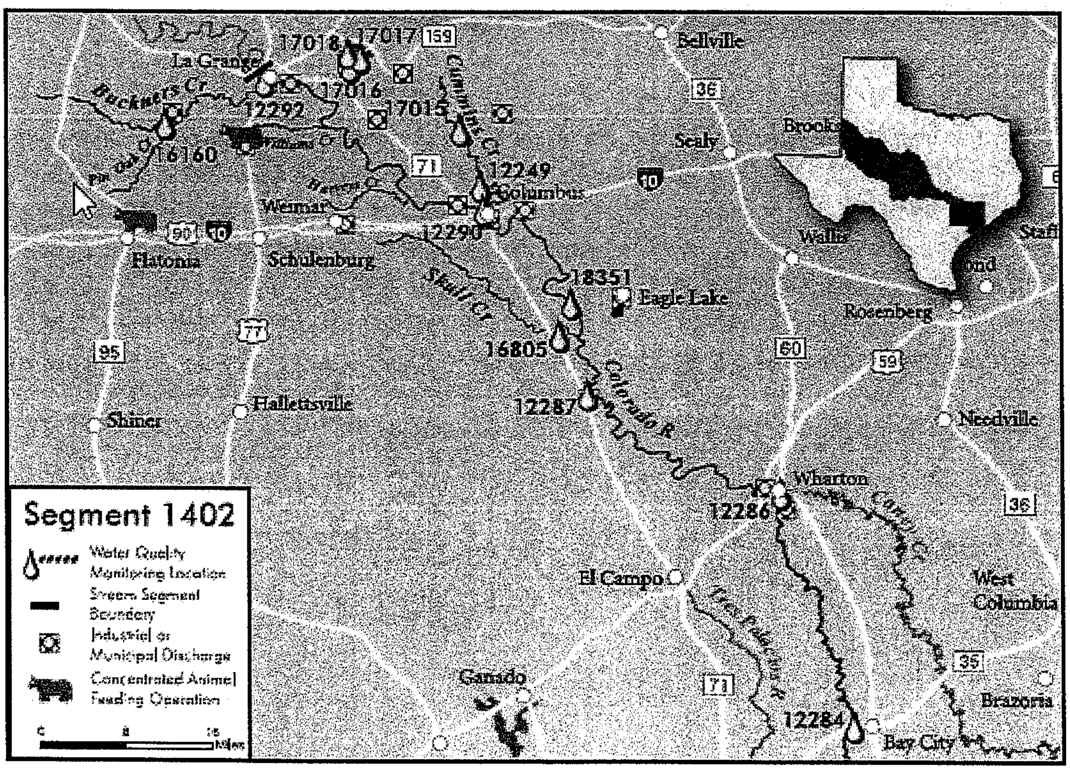


Figure 1 TCEQ segment 1402

Although I did not find specific information on riparian features or oxbows, a large oxbow just downstream of Columbus can be seen on Google Earth.

[1] http://waterquality.lcra.org/text/crplcbs2007.pdf

Figure 2 Google earth at Columbus

The gage at Columbus has been active since May 1916 (about 20 years prior to when the highland Lakes began regulating flows). The published 7Q2 statistic for this gage is 300 cfs (based on data from 1966-96). Calculated based on the 1917-1936 period it is surprisingly close at 296 cfs. Compared to the pre-highland lakes period median flows under current operating conditions are somewhat elevated in the summer; they generally appear to fall within the historic range of variability for the rest of the year. (Figure 3)

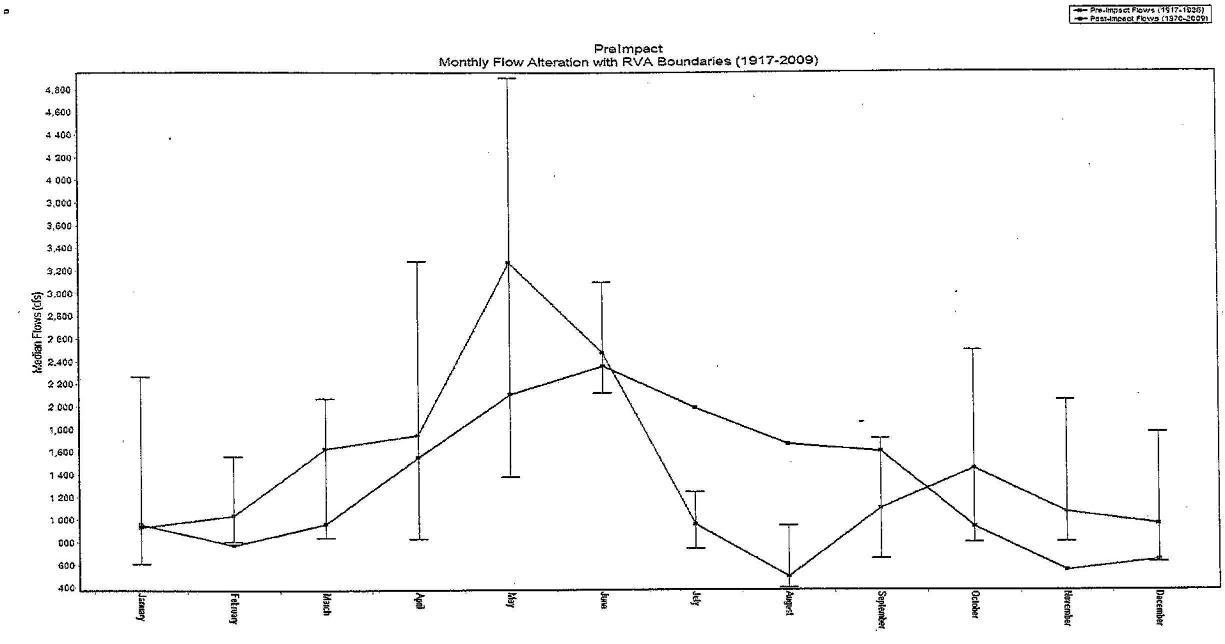


Figure 3 Monthly median flows pre- and post highland lakes

Very large flood events are now captured by the highland lakes, however bankfull flows (exceeding the National Weather Service flood stage of about 30,000 cfs) continue to occur with some frequency.

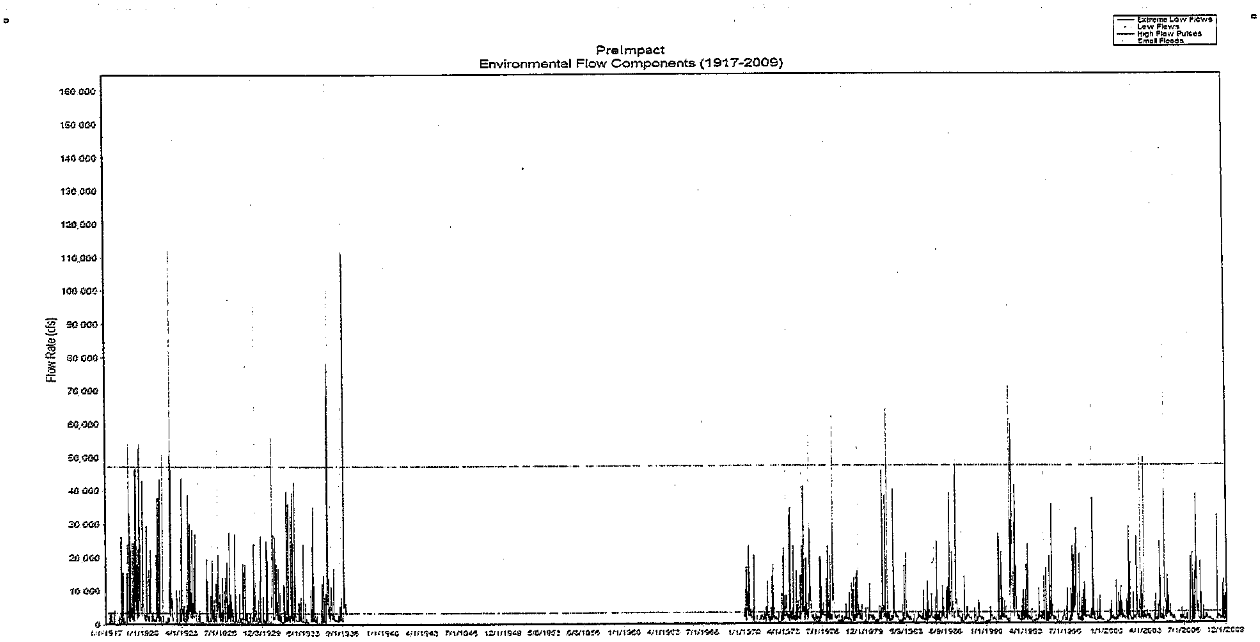


Figure 4 Historical hydrograph

Base flow statistics suggest low summer flows (10th and 25th percentile) have increased since the construction of the highland lakes and, to a lesser extent, that high winter base flows (75th percentile) are lower in the more recent period compared to the pre-impoundment period. This suggests that inter-annual variably appears to have been smoothed as a result of water development.

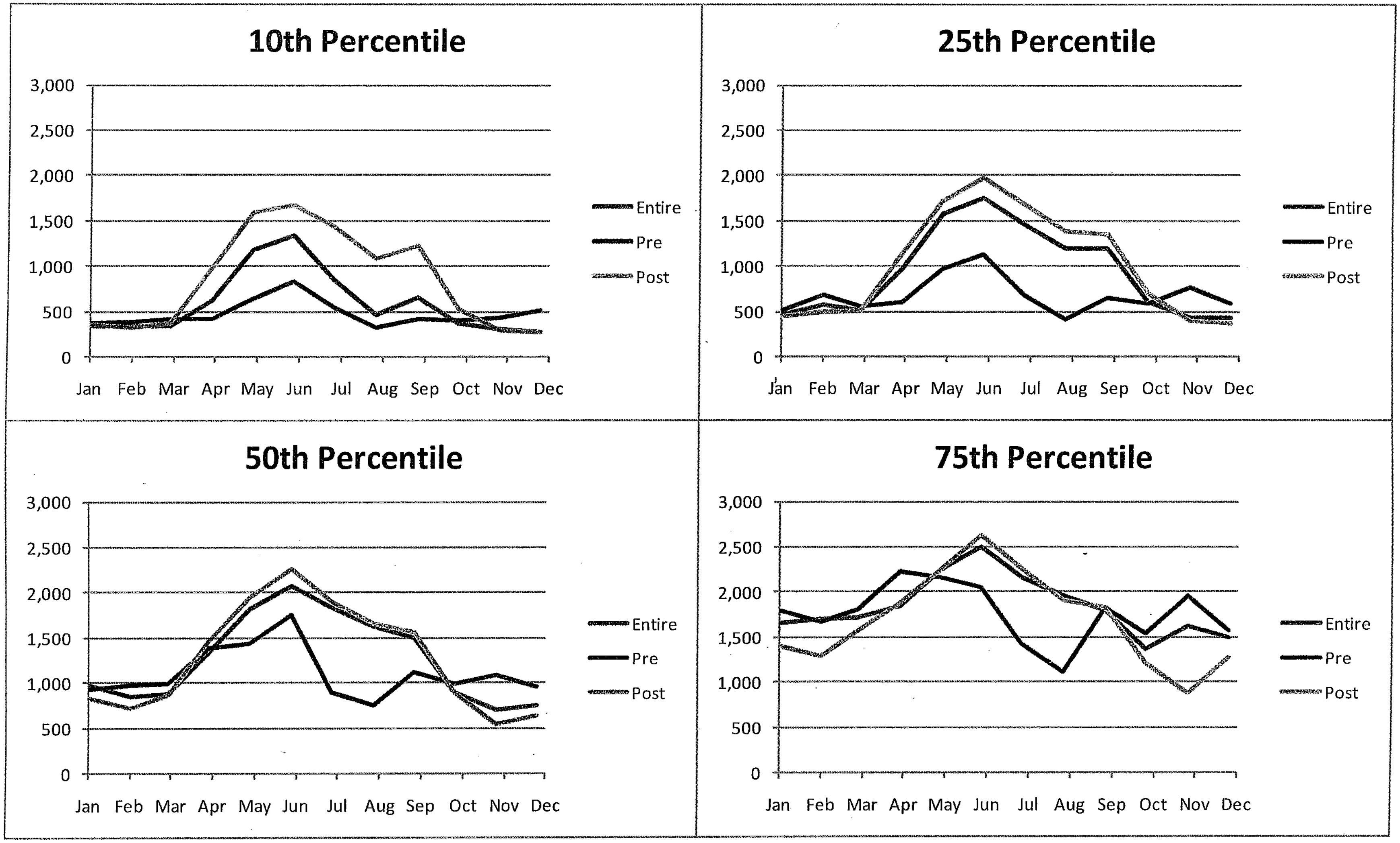


Figure 5 Base flow statistics

A comparison of naturalized flows between the pre highland lakes period and a more recent period (1977-2009) is not possible for this gage as the WAM do not extend to the period before the highland lakes. Therefore a comparison was made between annual flows from the 2 periods, based on the assumption (as yet untested that this courser statistic might be less subject to influence of the reservoir operations and more reflective of metrological differences between the two periods)

With the notable exception of 1917 (by far the driest year in the entire period of record in terms of annual flow) the per highland lakes flow are generally wetter than the more recent period. (I don't know how much to attribute this to the lakes impounding high flows or meteorological differences - I'm a bit surprised)

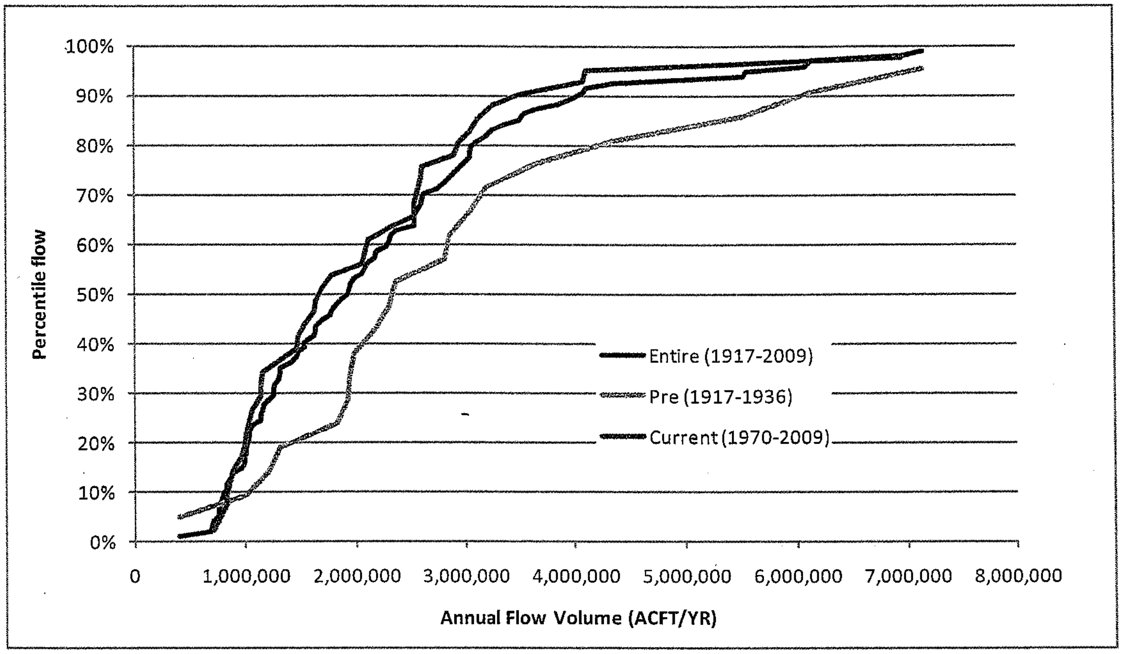


Figure 6 Annual percentile flows

Several years in which the total annual volumes were comparable were reviewed to try to gain additional insight into inter annual differences in the flow patterns. Figure 7 show two years with a total annual flow of about 100,000 acft (about the 10th percentile flow in the pre impoundment period and 20th percentile in the current period). These years indicate a typical effect of reservoir operations; low flows in the summer are elevated (likely due to summer releases to downstream irrigators) while spring high flows are lower perhaps due to the capture and storage of flows during the wetter period of the year.

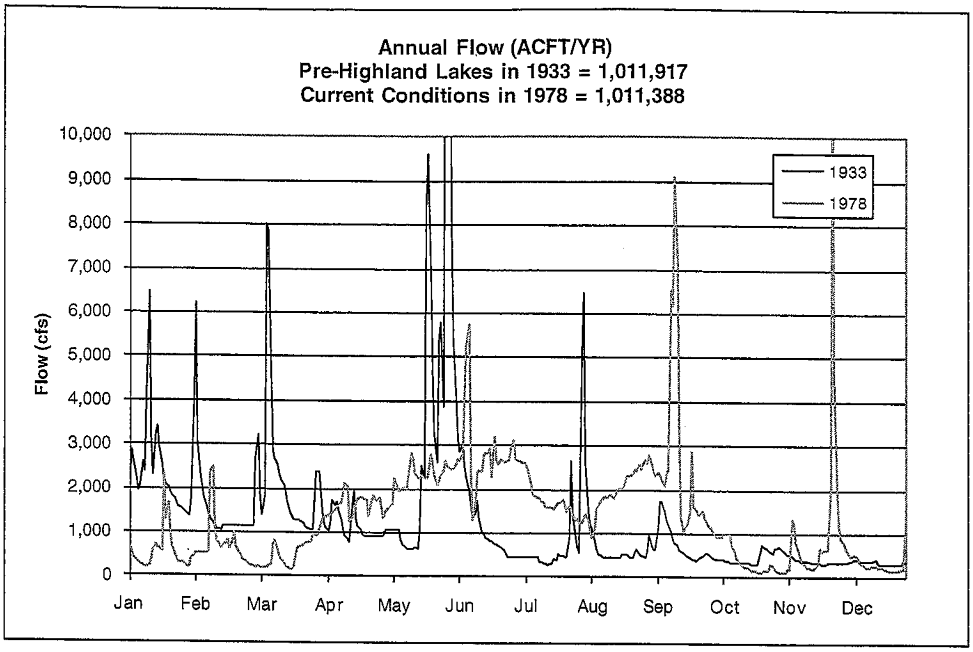


Figure 7 Example of annual hydrograph during relatively drier years

This elevated summer flows appears to persist at median (Figure 8) and higher (~90th percentile annual flows - Figure 9)

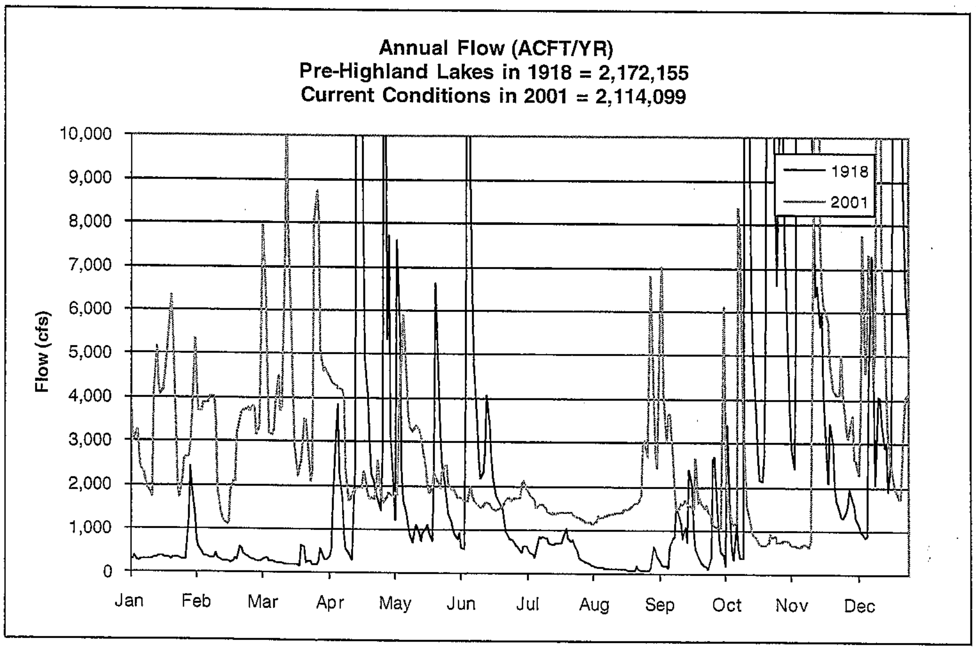


Figure 8 Example of annual hydrograph during relatively normal years

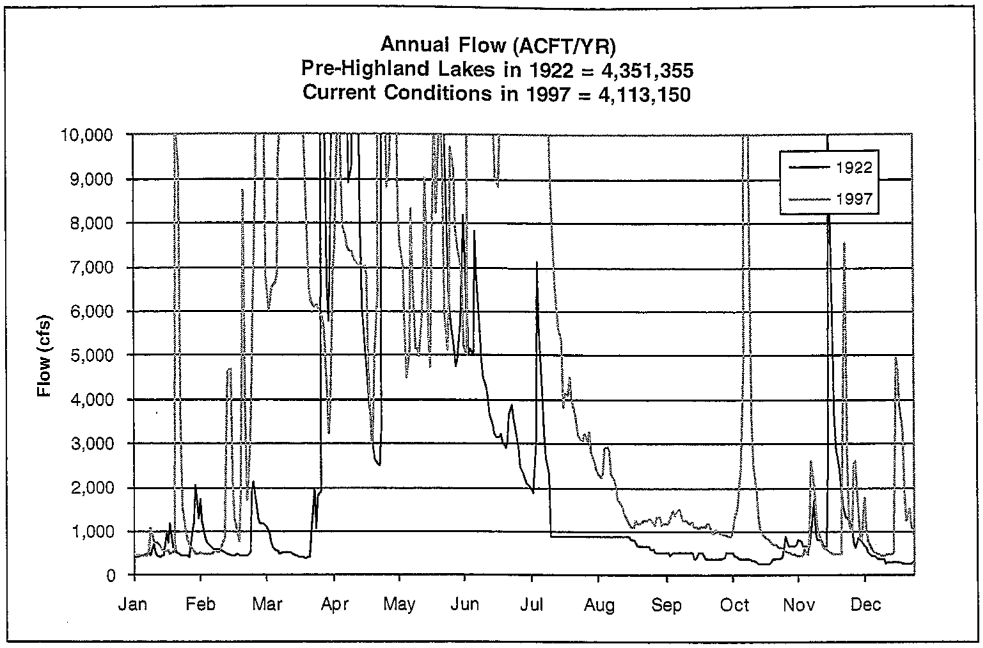
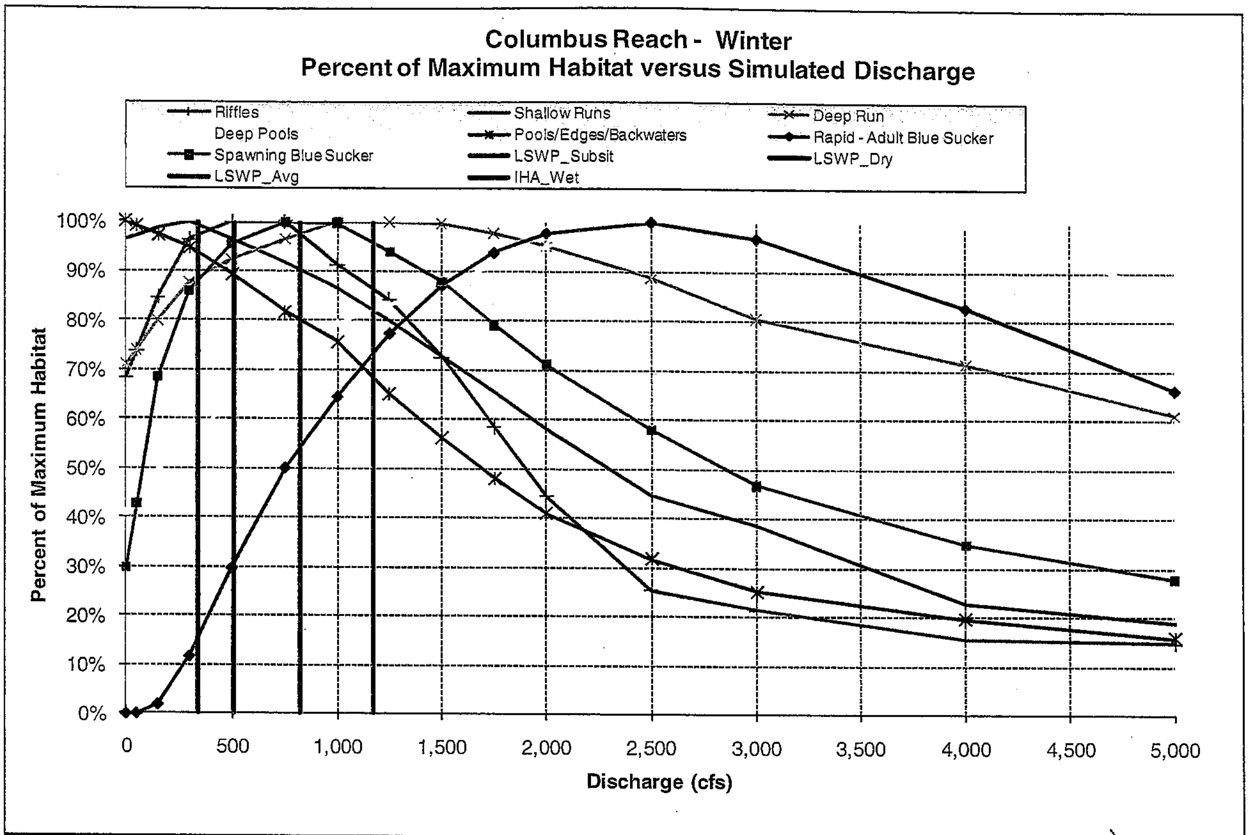


Figure 9 Example of annual hydrograph during relatively wetter years

This site has been the subject of extensive site specific evaluation including geomophological and instream habitat data collection and modeling. The recent LCRA-SAWS study recommended two based flow targets at this site based on an analysis that incorporated two-dimensional habitat modeling. The details of this analysis beyond the scope of this document however it should be noted that these tools could be used to evaluate an expected habitat response to other flows that the BBEST might consider evaluating. For example, the LCRA-SAWS study included flows that are fairly comparable to flows that might be produced by HEFR for the lower and medium base flows but, as noted by TPWD in their comments on this report, the LCRA-SAWS study did not recommend high base flows. Should the BBEST choose to evaluate such flows (and I am not suggesting that we necessarily should - there was a rational for not including three base flows) these models could be used to predict the habitat response of providing high base flows. Figure 10 provides an example of how such an analysis might be initiated. The black, red, and blue vertical lines approximate the winter flow recommendations from the study and the amount of each of the various habitat areas that are predicted at these flows. The green vertical line represents the flow that might be generated by a HEFR-type of analysis. Based on the habitat model one could conclude that adding a high base recommendation would generally increase rapid and deep pool habitat, have little effect on deep run and spawning blue sucker habitat and decease riffle, pool and shallow run habitat relative to the other recommendation flows.



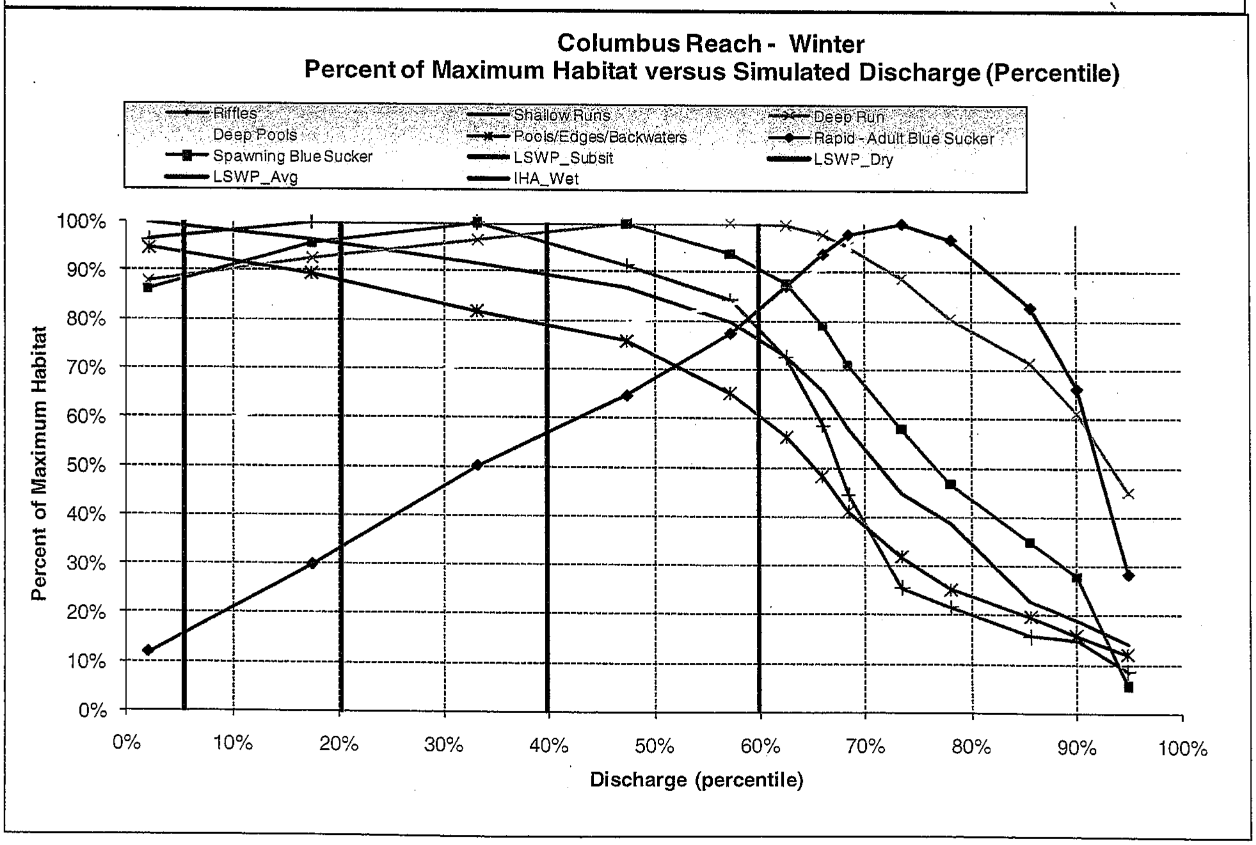


Figure 10 Weighted Usable Area v Flow Examples

COLORADO/LAVACA GAGE LOCATION FACT SHEET

INITIAL BBEST HYDRO TEAM OBSERVATION - JUN3 18, 2010

GENERAL GAGE INFORMATION

COLORADO/BBEST ID NUMBER (BBEST)	1
RIVER BASIN (TCEQ)	COLORADO
GAGE NAME (USGS)	COLORADO NEAR BALLINGER
USGS NUMBER (USGS)	
PERIOD OF RECORD FOR GAGED FLOWS (USGS)	1908-2009
PUBLISHED CONTRIBUTING DRAINAGE AREA (USGS)	
PUBLISHED 7Q2 AND BASIS PERIOD (TCEQ)	
FLOOD STAGE / DISCHARGE (NWS)	
WAM CONTROL POINT ID (TCEQ)	
PERIOD OF RECORD FOR ASSOCIATED WAM (TCEQ)	1940-1998

KNOWN MAJOR UPSTREAM INFLUENCES

MAJOR RESERVOIRS AND YEAR CONSTRUCTED:	SPENCE	1967
MAJOR RETURN FLOWS AND YEAR BEGAN	NONE	NA

SUB PERIODS OF RECORD REQUIRING SPECIAL INDEPENDENT CONSIDERATION

(1)	PRE MAJOR IMPACT	1908-1967
(2)	POST MAJOR IMPACT	1968-2009
(3)	RECENT	1970-2009
(4)	ENTIRE PERIOD OF RECORD	1908-2009
(5)	WAM PERIOD OF RECORD	1940-1998

FLOW STATISTISTS

GAGED FLOWS	1	2	3	4	5
AVERAGE ANNUAL					
MAXIMUM ANNUAL					
MINIMUM ANNUAL					

NATURALIZED FLOWS	1	2	3	4	5
AVERAGE ANNUAL	NA	NA	NA	NA	YES
MAXIMUM ANNUAL					
MINIMUM ANNUAL					

% GAGED IS OF WAM (ANNUAL AVG)					

HYDROLOGY INPUT DETAILS

BASE FLOW SEPERATION	
ALGORYTHEM	IHA
SUBSISTENCE	0.05
TYPE OF STATS	NON-PARAMETRIC
EAC DETAILS	
INITIAL HIGH/LOW SEPERATION	75 / 50
FLOWS BETWEEN RE-CLASSIFICATION THRESHOLD	25 / 10
SMALL FLOOD DEFINITION	98.8%
HEFR SPECIFICS	
CALENDAR YEAR	YES
PEAK MULTIPLIER	
SEASONS	DEFAULT
OVERBANK	1 PER 5Y
TIERS 1	1 PER 2Y
TIERS 2	1 PER 1Y
TIERS 3	I PER 2S
TIERS 4	1 PER S
TIERS 5	NA

HYDROLOGY OUTPUT DETAILS

	1	2	3	4	5
SUBISTENCE					
BASE LOW					
BASE MED					
BASE HIGH					
PULSE #1					
PULSE #2					
OVERBANK					